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(54) Title: CAR PARK SYSTEM AND METHOD FOR FACILITATING ENTRY AND EXIT

(57) Abstract: A car park system (10) and a method for facilitating entry to and exit from parking areas of the car park system (10) are described. An entry controller (30) of the entry system (12) has an entry list of license plate characters for vehicles permitted to park without a ticket. An entry camera (36) captures an image of a 10 vehicle to determine, based upon the entry list, whether the vehicle requires a ticket for entry. The license plate characters are then provided to an exit controller (50) at an exit. An exit camera (38) captures an image of a vehicle to enable the exit controller (50) to determine whether the vehicle requires a ticket for exit based upon an exit list stored in association with the exit controller (50).

CAR PARK SYSTEM AND METHOD FOR FACILITATING ENTRY AND EXIT

Field of the Invention

The present invention relates to car park systems that apply visual recognition of a vehicle's license plate characters for entry or exit. In particular, this invention relates to a car park system and method for facilitating entry and exit.

Background of the Invention

Car park systems that apply visual recognition of a vehicle's license plate characters to compute parking fees are known. Typically, one or more cameras capture an image of the license plate characters during entry to the parking areas of a car park system. The image is then converted to data for storage and subsequent processing. Upon capture of the image, entry to the parking areas is permitted. Usually, other information such as, for example, date and time of the vehicle's entry is also noted during entry. Such other information is then stored in association with the license plate characters.

When a user of the vehicle wishes to exit from the parking areas, payment of the parking fees is typically made at an exit. This requires the car park system to capture the license plate characters at the exit. Upon recognition of the license plate characters, the parking fees are computed and indicated to the user. Based on the computed parking fees, the user makes the payment and exit of the vehicle is then permitted after that payment is accepted. Payment collection known in the art includes, for example, a human operator or automated collecting devices. Such automated collecting devices include cash collecting machines, or a credit or cash card reader.

Alternatively, as described in Japanese Patent 9-319994, payment for parking fees of a vehicle is made with a ticket at a payment machine prior to the vehicle

moving to an exit. Thereafter, at the exit, the vehicle's license plate numbers are captured by a car number image pick-up section for verifying payment of the parking fees.

As described in the above, existing car park systems that are based upon recognition of license plate characters eliminate the need for users to hold onto tickets to compute parking fees. However, despite the conveniences of such existing car park systems, there is still a problem with such systems. This problem occurs when there is a failure to recognize the license plate characters by cameras that are placed at entries of these existing car park systems.

The failure to recognize the license plate characters may be due to faults in the cameras or when the license plate characters are not recognizable by the cameras. Instances of the latter situation occur, for example, when the license plate characters are obstructed from view. Unrecognized license plate characters also occur when a license plate is missing or when one or more of the license plate characters are damaged. Consequently, the vehicle may not enter the parking areas if the license plate characters are not recognized.

Furthermore, recognition of the license plate characters during entry to the parking areas does not guarantee that the license plate characters can be recognized for exit. This is because the license plate characters also have to be recognized at an exit to compute parking fees. Hence, the failure to recognize the license plate characters may occur at the exit even though entry to the parking areas was permitted or even after payment for parking fees of a vehicle has been made prior to the vehicle moving to the exit.

Regardless of whether the problem occurs at an entry or at an exit of a car park system, unrecognized license plates characters at such locations leads to congestion of vehicles. Therefore, a need clearly exists for improvements to existing car park systems that compute parking fees based upon license plate recognition to

thereby resolve, or at least alleviate, problems due to unrecognized license plates characters.

Brief Summary of the Invention

The present invention seeks to provide a car park system and method for facilitating entry to and exit from parking areas of the car park system.

Accordingly, in one aspect, the present invention provides a car park system comprising:

an image system for capturing and processing an image of license plate characters of a vehicle at an entry to parking areas of the car park system;

an entry system coupled to the image system to receive a license plate signal from the image system, the entry system being associated with the entry and having:

a movable entry barrier;

one or more entry detectors for detecting the vehicle at one or more predetermined areas of the entry;

a ticket generator;

and

an entry controller for controlling the movable entry barrier, the entry controller being coupled to the movable entry barrier, at least one of the entry detectors and the ticket generator, the entry controller having storage means for storing an entry list of license plate characters;

and

a system controller coupled to the image system to receive data from the entry controller, the data being associated with entry parameters of the vehicle.

In another aspect, the present invention provides a car park system comprising:

an image system for capturing and processing an image of license plate characters of a vehicle at an exit from parking areas of the car park system; and

an exit system coupled to the image system, the exit system being associated with the exit and having:

a movable exit barrier;

a ticket reader for reading a ticket when the ticket is presented by a user of the vehicle;

one or more exit detectors for detecting the vehicle at one or more predetermined areas of the exit;

and

an exit controller for controlling the movable exit barrier, the exit controller being coupled to the movable exit barrier, at least one of the exit detectors and the ticket reader, the exit controller having storage means for storing an exit list of license plate characters.

In yet another aspect, the present invention provides a method for facilitating entry to and exit from parking areas of a car park system, the method comprising the steps of:

capturing, with an image system, an image of license plate characters of a vehicle when the vehicle is detected at a predetermined area of an entry to the parking areas;

processing the image to provide the license plate characters to an entry controller;

and

determining, by the entry controller, whether the vehicle requires a ticket from a ticket generator to enter the parking areas based upon an entry list of license plate characters.

In a further aspect, the present invention provides a method for facilitating exit from parking areas of a car park system, the method comprising the steps of:

capturing, with an image system, an image of license plate characters of a vehicle when the vehicle is detected at a predetermined area of an exit of the parking areas;

processing the image to provide the license plate characters to an exit controller;

and

determining, by the exit controller, whether the vehicle requires a ticket to exit the parking areas based upon an exit list of license plate characters.

Brief Description of the Drawings

A preferred embodiment of the present invention will now be more fully described, by way of example, with reference to the drawings of which:

FIG. 1 illustrates a functional block diagram of a car park system in accordance with the preferred embodiment;

and

FIG. 2 and FIG. 3 are flow charts of a method for facilitating entry to and exit from parking areas of the car park system of FIG. 1.

Detailed Description of the Drawings

A car park system and a method for facilitating entry to and exit from parking areas of the car park system in accordance with a preferred embodiment of the invention are described. In the following description, details are provided to describe the preferred embodiment. It shall be apparent to one skilled in the art, however, that the invention may be practiced without such details. Some of these details may not be described at length so as not to obscure the invention.

There are many advantages of the invention. One advantage of the invention is that the car park system distinguishes between users who pre-pay for long term parking and other users who are paying for parking based on parking duration within a single day. Accordingly, tickets are only generated for the latter category of users at entries to parking areas of the car park system.

Another advantage of the invention is that the car park system facilitates exit of vehicles using the car park system. An exit controller, associated with an exit of the car park system, stores an exit list of license plate characters. The license plate characters of any vehicle wishing to exit from the parking areas are checked against this exit list. If found in the exit list, the exit controller permits such a vehicle to exit without having to present a ticket even though such a ticket is available.

A further advantage of the invention is that the car park system facilitates use of the car park system for pre-designated vehicles. Such pre-designated vehicles can be recognized during entry or exit to enable, for example, a waiver or a discount of parking fees.

Yet another advantage of the invention is that the car park system enables license plate characters of vehicles to be verified for users who lose their parking tickets. Verification of the license plate characters enables the car park system to compute parking fees correctly for such vehicles. Verifying and computing the parking fees of such vehicles alleviates fraudulent claims such as, for example, when a parking ticket is not lost but the penalty for losing the parking ticket is less than the parking fees required.

Referring now to FIG.1, a functional block diagram of a car park system 10 in accordance with a preferred embodiment of the present invention is illustrated. The car park system 10 comprises an entry system 12, an exit system 14, an image system 16 coupled to the entry and exit systems 12,14, and a system controller 18. The car park system 10 further comprises a payment station 20 for users to make payments for parking.

The entry system 12 is associated with an entry to parking areas of the car park system 10. The entry system comprises a movable entry barrier 22, a ticket generator 24 for generating a ticket to a user during entry of a vehicle, two entry detectors 26,28 and an entry controller 30. The two entry detectors 26,28 form a loop detection system that enables detection of a vehicle moving across two predetermined areas at the entry. The ticket generator 24 and the entry controller 30 are housed together and collectively labeled as an entry station 31.

The entry controller 30 couples to the movable entry barrier 22 and the entry detector 26. The entry controller 30 controls the movable entry barrier 22, which is coupled to the entry detector 28, to enable entry of vehicles to the parking areas in the direction indicated by an arrow 32.The entry controller 30 also controls the ticket generator 24 during the entry of a vehicle.

The entry controller 30 has a memory storage 34 for storing an entry list of license plate characters. The memory storage 34 can be, for example, a random access memory (RAM) or any other memory storage that allows updating of the entry list. Updates to the entry list are provided from the system controller 18. The license plate characters in the entry list correspond to vehicles of season pass holders. Such season pass holders have made pre-payments for parking the vehicles prior to entering the car park system 10.

License plate characters of a vehicle entering or leaving the parking areas of the car park system 10 are captured and processed by the image system 16. An entry camera 36 and an exit camera 38 are respectively located at the entry and the exit to the car park system 10. An image of the license plate characters of a vehicle at either the entry or the exit is captured by one of these cameras 36,38. The image is then transmitted to an image processor 40 for processing to generate a license plate signal.

The exit system 14 is associated with an exit of the car park system 10. The exit system 14 comprises a movable exit barrier 42, a ticket reader 44 for reading a

ticket provided by a user, two exit detectors 46,48 and an exit controller 50. The two exit detectors 46,48 form a loop detection system that enables detection of a vehicle moving across two predetermined areas at the exit. The ticket reader 44 and the exit controller 50 are housed together and collectively labeled as an exit station 51.

The exit controller 50 couples to the movable exit barrier 42 and the exit detector 46. The exit controller 50 controls the movable exit barrier 42, which is coupled to the exit detector 48, to enable exit of vehicles from the parking areas in the direction indicated by an arrow 52. The exit controller 50 also controls the ticket reader 44 during the exit of a vehicle.

The exit controller 50 has a memory storage 54 for storing an exit list of license plate characters. The memory storage 54 can be, for example, a random access memory (RAM) or any other memory storage that allows updating of the exit list. Updates to the exit list are provided from the system controller 18. The license plate characters in the exit list correspond to vehicles of both season pass holders and users who have paid for parking of their vehicles at the payment station 20.

The payment station 20 allows for users to make payment for parking their vehicles. Payment for parking requires a user to present a ticket obtained during entry. Upon the payment being made, the payment station provides data associated with the payment to the system controller 18. Such data includes the vehicle's license plate characters.

The system controller 18 updates the exit list and therefore helps to maintain the exit list current for users who have paid for parking. The system controller 18 also updates license plate characters of vehicles for which season parking payment have been made. For such vehicles the system controller 18 updates both the entry list and the exit list stored, respectively, at the entry controller 30 and the exit controller 50.

A method for facilitating entry to and exit from parking areas of the car park system 10 is described with two flowcharts 100,200 shown in FIG. 2 and FIG. 3 respectively.

Referring now to the flowchart 100 of FIG. 2, the method starts at step 102 and proceeds to step 104 in which an image of a plurality of license plate characters of a vehicle is captured by the entry camera 36. This image is captured when the vehicle is detected at a predetermined area before entry to the parking areas of the car park system 10. The predetermined area is associated with the entry detector 26.

Thereafter, the image is processed by the image processor 40 at step 106 to generate a license plate signal having the license plate characters, which is then provided to the entry controller 30.

The method continues to decision step 108 in which the entry controller 18 checks whether the vehicle's license plate characters are found in the entry list stored in the memory storage 34. With a 'Yes' following the decision step 108, the entry controller 30 permits entry of the vehicle to the parking areas at step 110. Otherwise, with a 'No' following the decision step 108, the entry controller 30 controls the ticket generator 24 to generate a ticket at step 112. After collecting the ticket, the method proceeds to step 110 for entry of the vehicle to the parking areas.

Referring now to the flowchart 200 of FIG. 3, the method continues to the flowchart 200 when a vehicle wishes to exit the parking areas. Starting at step 202, the method continues to step 204 in which an image of license plate characters of a vehicle is captured by the exit camera 38. This image is captured when the vehicle is detected at a predetermined area before exit from the parking areas of the car park system 10. The predetermined area is associated with the exit detector 46.

Thereafter, the image is processed by the image processor 40 at step 206 to generate a license plate signal having the license plate characters, which is then provided to the exit controller 50.

The method continues to decision step 208 in which the exit controller 50 checks whether the vehicle's license plate characters are found in the exit list stored in the memory storage 54. With a 'Yes' following the decision step 208, the exit controller 50 permits exit of the vehicle from the parking areas at step 210. Otherwise, with a 'No' following the decision step 208, the exit controller 50 generates a request for a ticket from a user of the vehicle at step 212.

It is to be noted that step 212 can be enabled using either a pre-recorded voice message that is played to the user or a visual display with which a pre-recorded display message can be displayed to the user. Such techniques to provide a respective message to the user is well within the scope of a person skilled in the art and need no further elaboration.

The exit controller 50 then checks at decision step 214 whether the ticket has been provided. With a 'No' following the decision step 214, the exit controller 50 proceeds to decision step 216. The exit controller 50 checks for this predetermined period of time to expire at the decision step 216. With a 'Yes' following the decision step 216 that indicates expiration of this predetermined period of time, the exit controller 50 alerts a human operator at step 218. Otherwise, if the predetermined period of time has not expired following a 'No' from the decision step 216, the exit controller 50 awaits for the ticket to be provided.

If the ticket is received within the predetermined period of time following a 'Yes' from the decision step 214, the method proceeds to decision step 220.

At decision step 220, the exit controller 50 verifies payment for the ticket. With a 'Yes' following the decision step 220, the exit controller 50 permits exit of the vehicle from the parking areas at step 210. This 'Yes' corresponds to payment for the ticket being verified.

Otherwise, with a 'No' following the decision step 220, the exit controller 50 generates a request to the user to validate the ticket. As with the step 212, the user can be notified of this request using either a pre-recorded voice message that is played to the user or a visual display with which a pre-recorded display message can be displayed to the user. Such techniques to provide a respective message to the user is well within the scope of a person skilled in the art and need no further elaboration.

The present invention therefore provides a car park system 10 and a method for facilitating entry to and exit from parking areas of the car park system 10 to overcome, or at least alleviate, the problems of the prior art.

It will be appreciated that although one preferred embodiment has been described in detail, various modifications and improvements can be made by persons skilled in the art without departing from the scope of the present invention.

Claims

1. A car park system comprising:

an image system for capturing and processing an image of license plate characters of a vehicle at an entry to parking areas of the car park system;

an entry system coupled to said image system to receive a license plate signal from the image system, the entry system being associated with the entry and having:

a movable entry barrier;

one or more entry detectors for detecting the vehicle at one or more predetermined areas of the entry;

a ticket generator;

and

an entry controller for controlling the movable entry barrier, the entry controller being coupled to the movable entry barrier, at least one of the entry detectors and the ticket generator, the entry controller having storage means for storing an entry list of license plate characters;

and

a system controller coupled to said image system to receive data from the entry controller, said data being associated with entry parameters of said vehicle.

2. The car park system as claimed in Claim 1, and further comprising at least one payment station, coupled to said system controller, for determining parking fees of said vehicle when said ticket is presented and providing payment parameters on said ticket upon payment of said parking fees.

3. The car park system as claimed in Claim 2, and further comprising at least one exit system coupled to said image system and said system controller, each of said at least one exit system being associated with an exit from said parking areas and having:

a movable exit barrier;

a ticket reader for reading said ticket when said ticket is presented by a user of said vehicle;

one or more exit detectors for detecting said vehicle at one or more predetermined areas of said exit;

and

an exit controller for controlling said movable exit barrier, said exit controller being coupled to said movable exit barrier, at least one of said exit detectors and said ticket reader, said exit controller having storage means for storing an exit list of license plate characters.

4. The car park system as claimed in Claim 3, wherein said system controller is adapted to determine whether said vehicle requires said ticket to exit from said parking areas based upon said exit list.

5. A car park system comprising:

an image system for capturing and processing an image of license plate characters of a vehicle at an exit from parking areas of said car park system;

and

an exit system coupled to said image system, said exit system being associated with said exit and having:

a movable exit barrier;

a ticket reader for reading a ticket when said ticket is presented by a user of said vehicle;

one or more exit detectors for detecting said vehicle at one or more predetermined areas of said exit;

and

an exit controller for controlling said movable exit barrier, said exit controller being coupled to said movable exit barrier, at least one of said exit detectors and said ticket reader, said exit controller having storage means for storing an exit list of license plate characters.

6. The car park system as claimed in Claim 5, and further comprising a system controller for determining whether said vehicle requires said ticket to exit from said parking areas based upon said exit list.

7. A method for facilitating entry to and exit from parking areas of a car park system, said method comprising the steps of:

capturing, with an image system, an image of license plate characters of a vehicle when said vehicle is detected at a predetermined area of an entry to said parking areas;

processing said image to provide said license plate characters to an entry controller;

and

determining, by said entry controller, whether said vehicle requires a ticket from a ticket generator to enter said parking areas based upon an entry list of license plate characters.

8. The method as claimed in 7, wherein said determining step comprises the step of:

generating said ticket when said license plate characters of said vehicle are not found in said entry list;

and

permitting entry of said vehicle to said parking areas upon collection of said ticket by a user of said vehicle.

9. The method as claimed in 7, wherein said determining step comprises the step of permitting entry of said vehicle to said parking areas when said license plate characters of said vehicle is found in said entry list.

10. The method as claimed in 7, and further comprising the steps of:

capturing, with said image system, an image of license plate characters of said vehicle when said vehicle is detected at a predetermined area of an exit from said parking areas;

processing said image to provide said license plate characters to an exit controller;

and

determining, by said exit controller, whether said vehicle requires a ticket to exit said parking areas based upon an exit list of license plate characters.

11. The method as claimed in 10, wherein said determining step comprises the step of:

generating a request for said ticket when said license plate characters of said vehicle are not found in said exit list;

and

checking whether said ticket has been provided.

12. The method as claimed in 11, and further comprising the step of verifying that payment has been made for said ticket when said ticket has been provided.

13. The method as claimed in 12, and further comprising the step of permitting said vehicle to exit from said parking areas when said payment is verified.

14. The method as claimed in 12, and further comprising the step of generating a request to a user of said vehicle to validate said ticket when said payment is not verified.

15. The method as claimed in 10, and further comprising the step of permitting exit of said vehicle from said parking areas when said license plate characters of said vehicle is found in said exit list.

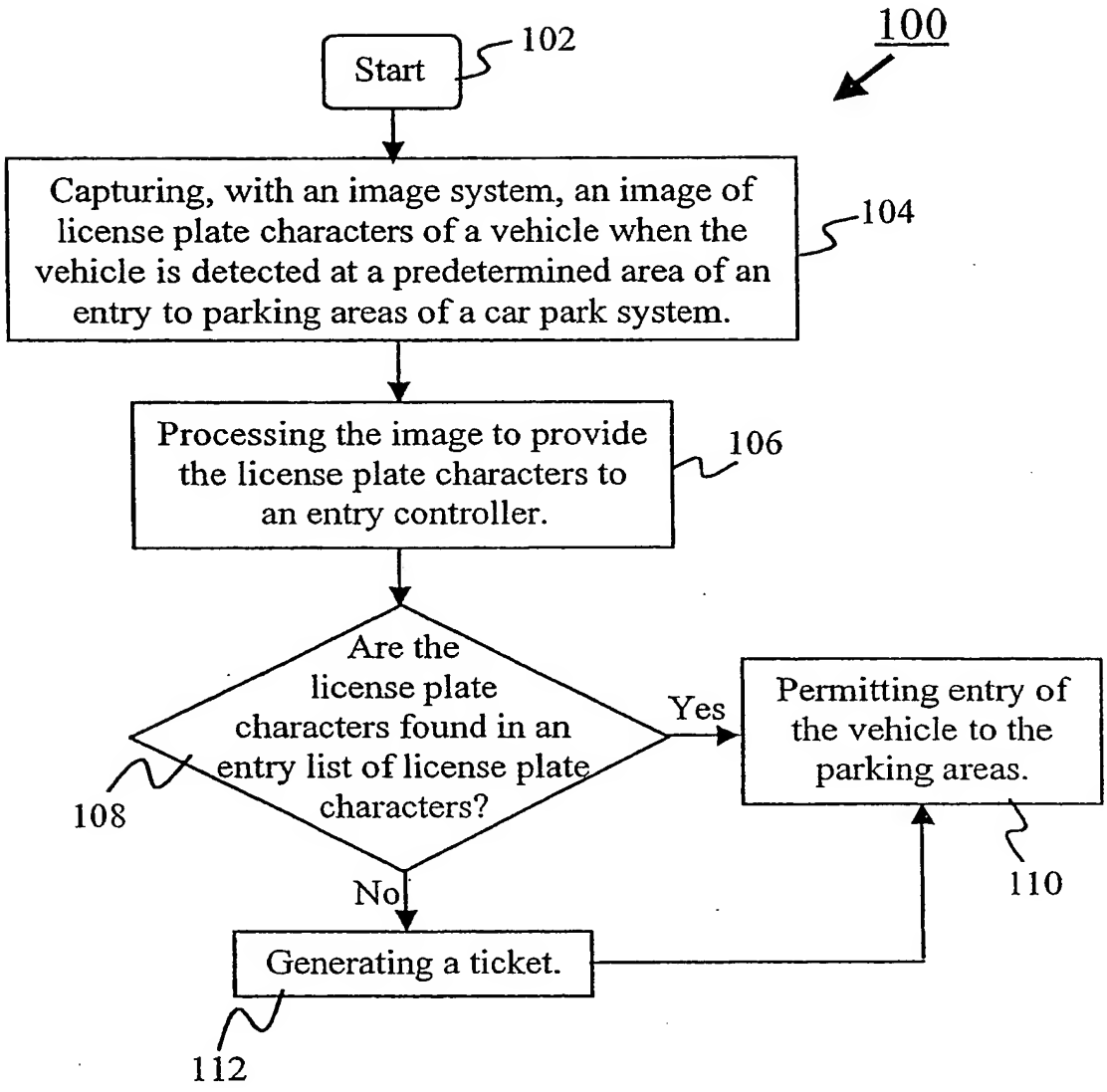
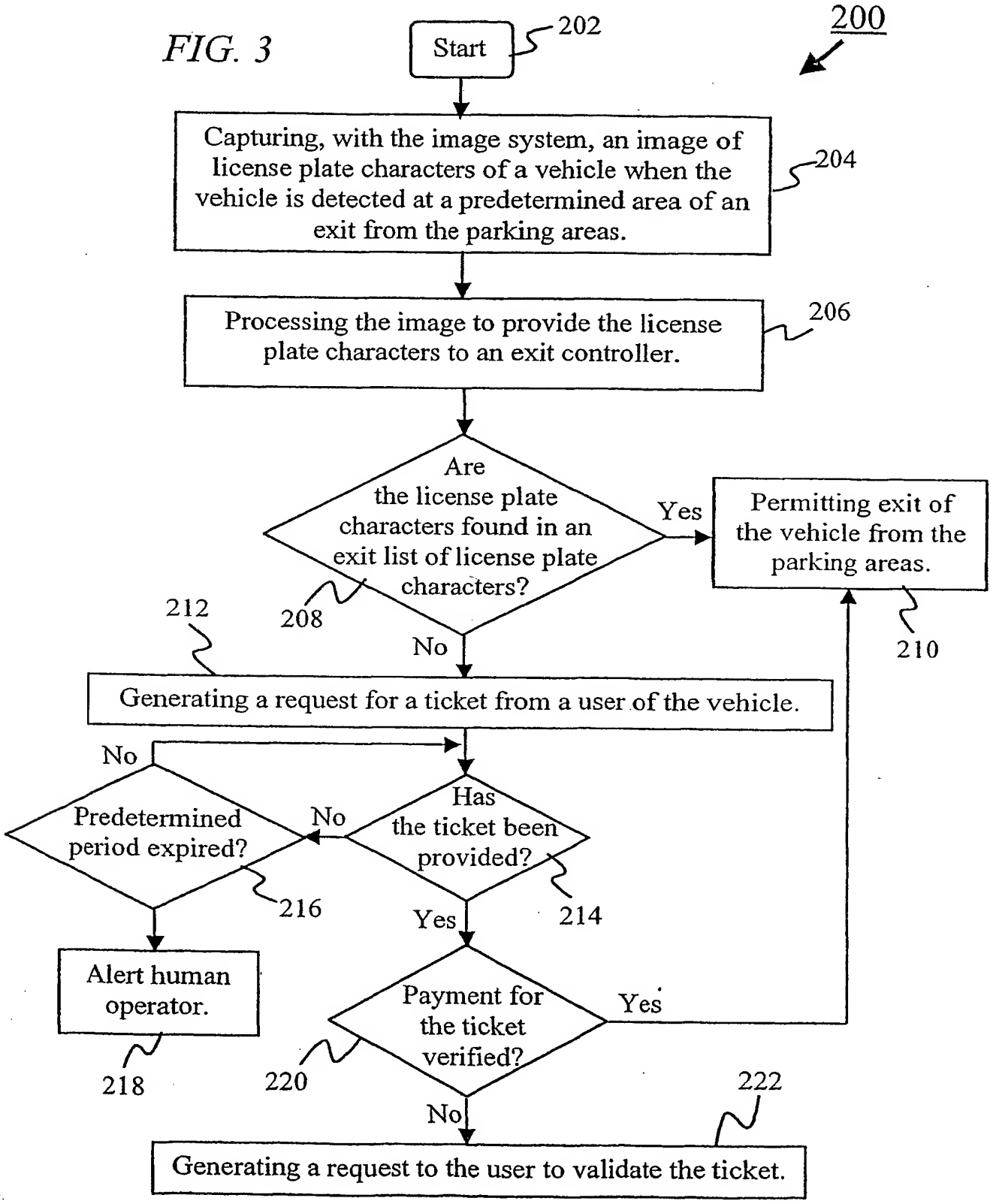

100
Start
102
Capturing, with an image system, an image of license plate characters of a vehicle when the vehicle is detected at a predetermined area of an entry to parking areas of a car park system.
104
Processing the image to provide the license plate characters to an entry controller.
106
Are the license plate characters found in an entry list of license plate characters?
108
Yes
Permitting entry of the vehicle to the parking areas.
110
No
Generating a ticket.
112

FIG. 3


200
Start
202
Capturing, with the image system, an image of license plate characters of a vehicle when the vehicle is detected at a predetermined area of an exit from the parking areas.
204
Processing the image to provide the license plate characters to an exit controller.
206
Are the license plate characters found in an exit list of license plate characters?
208
Yes
Permitting exit of the vehicle from the parking areas.
210
No
212
Generating a request for a ticket from a user of the vehicle.
No
Has the ticket been provided?
214
No
Predetermined period expired?
216
Yes
Alert human operator.
218
Payment for the ticket verified?
220
Yes
No
222
Generating a request to the user to validate the ticket.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG02/00220

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: G07B 15/04, G07C 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (7) : G07B 15/04, G07C 9/00, E04H 6/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent Patents File : Dwpi : keywords (imag+, scan+, captur+, detect+) (vehicl+, car+) (licen+, plate+, number, tag, registration, data)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 565014 A (ELEKTRENE S.r.l.) 13 October 1993. All document.	1-21
X	EP 908851 A (QUALITY INFORMATION SYSTEMS S.A.) 14 April 1999.	1-21
X	AU 53521/99 A (MEOW et al) 13 April 2000. All document.	1-21
Y	DE 3715314 A (GRUHL) 17 November 1988. All document.	1-21
Y	DE 20101094 U (DAUB) 7 June 2001. All document.	1-21
Y,P	EP 1160734 A (QUALITY INFORMATION SYSTEMS S.A.) 5 December 2001.	1-21

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2002	29 NOV 2002
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **DAVID LEE** Telephone No : (02) 6283 2107

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG02/00220

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	FR 2726385 A (HELLO SA) 3 May 1996. All document.	1-21
Y	GB 2302608 A (MATSUSHITA ELECTRIC INDUSTRIAL COMPANY LIMITED) 20 January 1997. All document.	1-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SG02/00220

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	565014	IT	1258319				
EP	908851	NONE					
AU	53521/99	HK	1027481	NZ	500162	SG	73556
DE	3715314	EP	313605	US	5034739	WO	8808910
DE	20101094	NONE					
EP	1160734	NONE					
DE	4444142	NONE					
FR	2726385	NONE					
GB	2302608	JP	9007014	US	5745052		

END OF ANNEX